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ABSTRACT

The contribution of decentration as an underlying component of discrimination learning and discrimination shift behavior was investigated in this study. In addition, the effect of verbal labeling and the relationship of academic achievement to discrimination learning and decentration was considered. The subjects were 120 first grade students who were identified and placed within subgroups of either high or low decentration and one of three verbal labeling groups. The results did not support the hypothesis that facility in decentration is an underlying component of successful discrimination problem solving or discrimination shift behavior. In addition, verbal labeling did not facilitate discrimination learning or shift behavior. The saliency of the stimulus was found to be related to both facility in discrimination learning and likelihood of reversal shifts. Finally, academic achievement was shown to be consistently related to ability to decenter, while success of discrimination learning and shift behavior was unrelated to academic achievement. (Author)

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Decentration, Discriminative Shift Behavior, Verbal Mediation, and Academic Achievement in Young Children

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Running head: DECENTRATION, DISCRIMINATIVE SHIFT BEHAVIOR

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Abstract

The contribution of decentration as an underlying component of discrimination learning and discrimination shift behavior was investigated in this study. In addition, the effect of verbal labeling and the relationship of academic achievement to discrimination learning and decentration was considered. The subjects were 120 first grade students who were identified and placed within subgroups of either high or low decentration and one of three verbal labeling groups. The results did not support the hypothesis that facility in decentration is an underlying component of successful discrimination problem solving or discrimination shift behavior. In addition, verbal labeling did not facilitate discrimination learning or shift behavior. The saliency of the stimulus was found to be related to both facility in discrimination learning and likelihood of reversal shifts. Finally, academic achievement was shown to be consistently related to ability to decenter, while success of discrimination learning and shift behavior was unrelated to academic achievement.

Discriminative Shift Behavior, Verbal Mediation, Decentration and Academic Achievement in Young Children

Concept formation, in general, and discriminative learning, in particular, have been central issues within psychology for decades (Hull, 1943; Lawrence, 1949, 1950; Spence, 1936, 1940; Thorndike, 1931). Two basic theoretical positions have developed within psychology to explain discrimination learning. Spence's continuity theory is consistent with trial and error learning, while Lawrence suggested the notion of mediating processes between the stimulus and response as the essential basis for discrimination learning. Spence developed the discrimination shift paradigm to study research questions involved in discrimination learning and this methodology has since been progressively modified and adapted to accommodate a variety of research hypotheses concerning discrimination learning and dsicrimination shift behavior (Buss, 1953, 1956; Kendler and D'Amato, 1955; Kelleher, 1956; Kendler and Kendler, 1959, 1962; Kendler, Kendler, and Wells, 1960). Kendler and Kendler (1959) have suggested that there is a "transitional process in the development of concept formation in children from behavior rendered accountable by a single-unit S-R theory to the

more complex responses associated with the mediational-sequential S-R theories" (p. 56).

One possible means of explaining the differences in shift behavior between young children and older children is the notion that the latter group may be employing covert language. While Kendler (1964) noted that verbalization is a form of mediational behavior, she nonetheless also noted another possibility, namely that "verbalization was effective because it activated a perceptual response which is not incompatible with the theoretical model in its present stage" (Kendler, 1964, p. 434). Following this conjecture, a variety of studies have been conducted to investigate discrimination shift behavior as it relates to language, perceptual variables, and overtraining (Adams and Shepp, 1975; Casey, 1975; Kendler and Kendler, 1966; L. S. Tighe, 1965; Tighe and Tighe, 1965, 1966, 1970). Among other findings, this research has indicated that the provision of verbal labels enhanced a child's tendency to make reversal shifts, but this finding was complicated by the fact that the children sometimes used verbal labels that were contrary to their overt choices (Kendler, 1964).

With the continued study of discrimination shift behavior in children, additional theoretical positions have been suggested to account for such phenomenon as the effects of verbal labels on shift behavior and the robust

finding of an increase in reversal shifts as children mature (Levine, 1966; Tighe & Tighe, 1966; and Smiley and Weir, 1966). Thus, the multiplicity of specific theoretical explanations of discrimination learning indicates that the cognitive mechanisms operating within the child continue to be a point of contention.

Piaget has provided the most widely accepted theory of cognitive development (1928, 1950, 1954, 1977), and it is relevant to note that the period of cognitive transition from preoperational to concrete operational thought encompasses the developmental change from nonreverser to reverser in discrimination shift learning. Indeed, Shibata (1976) has provided an initial challenge to the mediational theory of the Kendlers based upon a Piagetian-developmental approach. Shibata concluded that as the child moves into the concrete operational stage the child becomes capable of evaluating the multiple stimulus dimensions which forms the basis of mediational responding in discrimination learning. While Piaget has identified a series of cognitive mechanisms that account for the differences between preoperational children and concrete operational children (irreversibility, egocentricism, centering, transductive reasoning, and concreteness), the concept of centering, or decentering, appears to be particularly relevant to discrimination shift behavior. Pulaski (1971)

notes that centering is important for explaining the changes associated with the cognitive maturation because

> . . . it explains several kinds of phenomena. For one thing, it accounts for error in perception. A lot of details may be overlooked in a hasty first encounter; the eye tends to fixate or <u>center</u>, to use Piaget's term, on only the most compelling elements. This leads to a distorted perception, which must then be gradually corrected by <u>decentering</u> (Pulaski, 1971, p. 154).

In this study the role of decentration as a possible explanatory mechanism in discrimination shift learning will be investigated. If decentration is an underlying mechanism of discrimination learning, it is expected that facility in decentration will be associated with children who are more likely to be identified as reversers during the optional shift phase of discrimination tasks. In addition, the role of verbal labeling will be considered as it relates to facility in discrimination shift learning. The supplying of verbal labels would be expected to facilitate reversal shifts if children are employing verbal mediational strategies in discrimination learning. Finally, both discrimination shift behavior and decentration will be examined in relation to the development of academic skills. The educational implications of discrimination

shift behavior and decentration are most obviously related to the child'sacademic skills. Further, analysis of academic skills provides an expanded perspective for clarifying the relationship between discrimination shift behavior and decentration.

Method

Subjects

Initially, 212 first-grade children from a rural Texas community were administered the six decentration tasks. Within this group 104 were males and 108 were females, ranging in age from 66 to 97 months, with a mean age of 81.6 months and a standard deviation of 5.13 months. The 60 S's who scored in the top 27th percentile (Kelly, 1929) were assigned to the high decentration group, while the 60 S's who scored in the lower 27th percentile were assigned to the low decentration group. After this separation, each decentration group was further subdivided by randomly assigning each S to one of three verbal mediation treatment groups: verbal labeling, vicarious mediation, or control. Thus, from the original 212, there were 120 S's that were selected as subjects by inclusion in one of six subgroups.

Apparatus

The materials employed for the decentration tasks were based upon those employed by Phillips (1969). All stimuli for the discrimination shift task were presented to the S

on an Apple II microcomputer. The stimuli consisted of a solid amber icon of either a big or little triangle or a big or little square. A light pen was used so that each S could select the desired stimulus on the CRT. The microcomputer recorded all responses.

Procedure

Each S was tested on his or her ability to decenter using six different decentration tasks following the procedure used by Phillips (1969). Each of the six tasks was administered three times so that there was a total of 18 decentration trials for each S.

The stimuli for all phases of the discriminative shift task differed on two dimensions, size and shape. The size dimension consisted of a large square or triangle (6.3 mm high) or a small square or triangle (3.2 mm high). The shape dimension consisted of a square or triangle.

The discriminata were presented one pair per trial. Each pair differed simultaneously between dimensions and within dimensions. The stimuli were presented in a random sequence so that each stimulus appeared approximately equally on the right and left, and the positive stimulus appeared approximately equally on the right and left, but in neither case did a stimulus or reinforcement occur more than two consecutive times in one position. The only exception was after an incorrect trial. In this case the

relative positions remained constant until a correct response was exhibited. This exception was specified to discourage position habits (Kendler, 1964).

The initial discrimination ended when the S had achieved a criterion of 9 correct in 10 trials. Without a pause in the routine or notice to the S, series II began immediately. In series II, the optional shift, the reinforcement pattern was reversed so that the previously positive stimulus became negative, and vice-versa. The optional shift continued until the criterion of 9 correct responses of 10 consecutive trails was reached. Series III, the test discrimination, was used to determine what value the S had responded to during the optional shift series. S were identified as reversers if they made a intradimensional shift in 8 of 10 trials during the test discrimination. Likewise, S were identified as nonreversers if they made an interdimensional shift in 8 of the 10 final trials. S's with fewer than 8 of 10 consistent responses were classified as inconsistent shifters.

Prior to being presented with the discriminative tasks, each S was randomly assigned to one of three verbal labeling groups. In the verbal labeling group, the S's were required to orally label and point with their finger to the stimulus, prior to making a selection with the light pen. S's in the vicarious mediation group were not

required to provide an overt oral label since each of the stimuli was orally labeled by the experimenter prior to the S 's selection. In the third group, no verbal labels were provided by either the experimenter or the subject.

Finally, all S's were administered the Metropolitan Readiness Test for first grade students (level II). For each child ten discrete scores were obtained -- beginning consonants, sound-letter relationships, visual matching, finding patterns, school language, listening, total pre-reading, quantitative concepts, quantitative operations, and total quantitative.

Results

The data were analyzed in four major sections. First, the results for series I of the discrimination shift were analyzed using analysis of variance. Second, using chi-square, results for series III of the discrimination shift were evaluated. Third, data about the stimulus value relevant in series I was considered, by use of analysis of variance. Finally, analysis of variance was employed to examine differences in academic achievement within decentration and verbal mediation groups.

Series I

Each S's score on Series I was based upon the number of trials to learn the initial discrimination. A 3 x 2 (decentration by verbal labeling group) fixed-effects

analysis of variance was employed to analyze differences between decentration groups and verbal labeling groups, as well as any possible interaction. This analysis yielded no significant main effect for decentration, F (1,114) = 2.038, $p > .05$, no significant main effect for verbal mediation, F (2,114) = 2.038, $p > .05$, and no significant interaction effect, F (2,114) = 0.279, $p > .05$.

Series III

The data for series III consisted of the frequency of reversal shifts among S's. A 2 x 3 chi-square comparison was made to determine if there would be a significant association between the number of S's making a reversal shift and high or low decentration. The resulting chi-square was insignificant, X^2 (2, N = 120) = 2.67, $p > .05$. A similar analysis was done to determine if there would be a significant association between the number of S's making a reversal shift and verbal labeling classification. As before, the chi-square yielded no significant association, X^2 (4, N = 120) = 0.81, $p > .05$.

Relevant Stimulus Value

While the experimenters did not initially anticipate that the stimulus value (square, triangle, big, little) would have an effect of the S's performance, inspection of the data suggested otherwise. Therefore, a 2 x 4 fixed effects analysis of variance was computed to test for

significance between decentration treatment and the relevant stimulus value in series I. The number of trials required to learn the initial discrimination was the dependent measure. This analysis showed a significant main effect for stimulus value, F (3,112) = 4.709, $p < .01$, but no significant main effect for decentraion, F (1,112) = 1.001, $p > .05$, and no significant interaction effect, F (3,112) = 0.123, $p > .05$. Tukey's Test for differential main effects (Linton and Gallo, 1975) showed that, among the relevant stimuli in series I, the triangle (M = 32.50) and big (M = 10.83) values differed significantly ($p < .05$) from each other. When big was the relevant stimulus in series I, S's took significantly fewer trials to learn the initial discrimination than when triangle was the relevant stimulus.

A 3 x 4 fixed effects analysis of variance was also computed to test for significance between the verbal mediation groups and the stimulus relevant in series I. Again, there was a significant main effect for the relevant stimulus, F (3,108) = 5.151, $p < .002$, but there was no significant main effect for verbal mediation, F (2,108) = 2.377, $p > .05$, and no significant interaction effect, F (6, 106) = 1.876, $p > .05$. Tukey's Test showed that the big (M = 10.83) and square (M = 26.17) stimulus values differed significantly from each other ($p < .05$) and that

big (M = 10.83) and triangle (M = 32.50) also differed significantly from each other. The S's who had big for the relevant stimulus in series I took significantly fewer trials to learn the initial discrimination that S's who had either square or triangle relevant in the initial discrimination.

To test for a significant association between the relevant stimulus value and the type of shift executed in series III, a 3 x 4 chi-square was computed. Results of this analysis indicated a significant association between the relevant stimulus value and type of shift S's made in series III, X^2 (6, N=120) = 22.70, $p < .01$. The stimulus value big produced the highest frequency of reversal shifts and the lowest frequency of both nonreversal and inconsistent shifts.

Academic Achievement

A one-way analysis of variance was conducted to test for significant differences in academic achievement between students classified in either the high decentration group or the low decentration group. For each of the ten subtests of the Metropolitan Achievement Test, a separate one-way analysis of variance, fixed effects, was conducted. The results indicated that there were significant differences between students in the high and low decentration groups for each of the academic subtests

on the Metropolitan. These results are summarized in Table 1.

Insert Table 1 about here

Similarly, differences between the groups identified as reversers, nonreversers, and inconsistent shifters were examined by use of a simple one-way analysis of variance. A separate analysis of variance was conducted for each of the ten subtests of the Metropolitan Achievement Test. The results indicated no significant differences between reversers, nonreversers, or inconsistent shifters for any of the ten academic subtests.

Discussion

Decentration Treatment

In the book entitled Cognitive Development (1985), Thomas Gross suggests that "if preschool children lack operative knowledge (the ability to decenter [italics added], reverse thought, and construct class hierarchies), their performance should be characterized, as it is, by the inefficient use of logical rules and nonstrategic, stereotyped hypothesis patterns" (p. 165). Contrary to this prediction, the results of the present experiment did

not provide support for the hypothesis that first graders' ability to decenter would have a significant effect on their performance on a discriminative problem solving task. The lack of significant results suggests that children's relative ability to decenter does not account for their success in learning perceptual discriminations of the type involved in simple discrimination tasks. While perceptual components are clearly involved in any decision making task that relates to external objects, it can be inferred that discrimination learning and decentration tasks make largely different and independent demands on the cognitive system. Discrimination learning of the type employed in the present experiment requires focused visual attention to a stimulus that can vary in either size or shape. Decisions are essentially binary choices relating to changes in these features or changes within a dimension. Responses were made in a nonverbal manner. In contrast, decentration tasks present a variety of stimuli in contexts that differ considerably from one task to the next. Responses are typically verbal and may require justification of the decision. Indeed, the very nature of traditional procedures to measure decentration have been criticized by researchers such as Donaldson (1979) and Trabasso (1979) due to the biasing of the presentation toward "subordinate class comparisons, ambiguous class

references, and mutually exclusive forms of or" (p. 177). Clearly, the cognitive processes involved in decentration tasks are complex and more varied when compared to the more basic components of discrimination learning.

Facility in decentration is not only unrelated to success in learning the initial discrimination, but it also is not predictive of whether children will make more reversal shifts. While it has been shown that the ability to make both reversal shifts and correct decentration choices is a function of age, the underlying cognitive mechanisms appear to be concurrent but parallel. This is consistent with the previous discussion suggesting that rather different underlying cognitive strategies and processes are involved. For example, Casey (1975) has suggested that in discrimination shift problems children can employ a response-shifting strategy when confronted with successive nonreinforcements. Tighe and Tighe (1972) suggest that in discrimination learning young children may employ a "shift response" strategy where they shift to a different response alternative regardless of the feedback they receive. Such strategies are clearly not particularly relevant to decentration tasks.

Additional evidence supporting the distinctive nature of discrimination learning versus decentration is provided by examining the relationship of these tasks to academic

achievement skills. Discrimination learning and discrimination shift behavior were statistically independent of academic performance, while facility in decentration was highly indicative of academic performance. This was a very robust and consistent finding across a variety of academic tasks. It can be inferred that the more diverse and complex cognitive processes involved in decentration have considerable common variation with the components of academic performance for children of this age group. Discrimination learning tasks, in contrast, appear to make cognitive demands that have little bearing upon the performance of academic skills in reading, language, or arithmetic. Clearly, some children are more capable of learning initial discriminations or more likely to exhibit reversal shifts, however, facility in these areas for this age group was not related to academic performance in any skill area. By the time children enter school, discrimination learning tasks of the type employed in this study and so common to the literature appear to have little direct relevance to understanding the underlying cognitive components of academic performance.

Another area of investigation in the present experiment focused of the role of mediation in discrimination learning. Previous research and speculation by the Kenders (1964) suggest that verbal labeling would produce

significant differences in both the number of reversal shifts and the number of trials required to learn initial discriminations. These hypotheses were not supported in the present research. Other investigations by the Kendlers (1964) have, at times, also failed to support any effect for verbal labeling treatments. Thus, it appears that simply having children produce verbal labels, or exposing children to vicarious labeling, does not appear to be a reliable method of inducing mediation. Luria's (1957) notion of "mediational deficiency" may help to explain why verbal labels do not reliably produce behavior indicative of verbal mediation in young children. Indeed, research suggests that requiring young children to process visual and verbal aspects of a stimulus may degrade performance (Finkle, 1973; Maisto & Baumeister, 1975) . Other researchers (Trabasso, Isen, Dolecki, McLanahan, Riley & Tucker, 1978) have focused on the nature of the verbal label. They suggest that verbal labeling is not sufficient to ensure the child encodes a stimulus; the typicality of the exemplars (labels) for any given child appears to be the critical variable.

This speculation finds some support in the present study. Of the four stimulus values -- square, triangle, big, and little -- the big value consistently facilitated both reversal shifts and initial discrimination learning.

This outcome is supported by previous research (Hamashige, 1980; Kendler, 1974; Kendler, Basden, & Bruckner, 1970; Kendler & Kendler, 1970; Smiley & Weir, 1966). However, Kendler & Kendler (1970) indicate that random sampling and a counterbalanced design, which were employed in the present study, should negate any effects of dimensional preference. This was clearly not the case. If, as Trabasso et al (1978) suggest, verbal labels are effective to the extent that the label is a typical and accepted one, then it is tenable that a ordered dimensional preference develops in an systematic and predictable fashion. The development of this hierarchy would depend upon both perceptual constraints and the child's exposure to various exemplars. For example, in the present experiment, big was a more typical exemplar for most first grade children than triangle or square, so the big stimulus value was more easily encoded and the subsequent discrimination and reversal more quickly mastered. Young children may have more difficulty learning discrimination tasks than older children and adults because the young children, by nature of their relatively limited experience with a variety of exemplars and relatively inflexible ordering, cannot readily adapt to less familiar labels. Indeed, it is clear that adults maintain a associative preference for the attachment of verbal labels to stimulus values (Nelson &

Kossiyn, 1975; Chi & Kaeske, 1983), but adults are apparently more flexible in their ability to rearrange the order of exemplars based upon reinforced and nonreinforced trials in a discrimination shift task. This would account for the fact that dimensional dominance does not affect optional shift performance in adults (Kendler & Kendler, 1970).

Taken together, the results of this study indicate that processes involved in decentration do not appear useful in explaining discrimination learning. The cognitive processes underlying decentration are varied and complex, as indicated by the consistent relationships between decentration and a variety of academic skills. In contrast, discrimination shift learning appears to be based upon cognitive processes that are more task specific and consequently unrelated to most academic skills. The contribution of verbal mediation to discrimination shift behavior continues to be difficult to identify -- in this study the physical characteristics of the stimuli clearly affected discrimination learning and shift behavior across a variety of experimental conditions. Additional study related to the interaction of the child's knowledge and experience with various dimensions of discriminative stimuli might clarify the contradictory results of past efforts devoted to examining the role of verbal mediation in discrimination learning with young children.

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Table 1

F Ratios Obtained for Differences between Decentration Groups

Dependent Variable	F Ratio	F Probability
Beginning consonants	17.329	0.0001
Sound-letter	27.721	<0.0001
Visual matching	17.529	0.0001
Finding Patterns	40.089	<0.0001
School language	23.059	<0.0001
Listening	8.561	0.0042
Total pre-reading	40.553	<0.0001
Quantitative concepts	34.001	<0.0001
Quantitative operations	43.220	<0.0001
Total quantitative	49.816	<0.0001

Note. N = 113